REMARKS

Claims 1-6, 11, and 13-20 remain pending in the application upon entry of this amendment. In addition to previously cancelled claims, claim 8-10 and 12 are canceled herein. Favorable reconsideration of the application is respectfully requested in view of the amendments and following remarks.

I. REJECTION OF CLAIMS 1-6, 11, AND 13-20 PURSUANT TO 35 U.S.C. § 103(a)

A. Claims 1-6, 11, and 13-18

Of the remaining claims, claims 1-6, 11, and 13-18 stand rejected pursuant to 35 U.S.C. § 103(a) as being obvious over Barnes et al., U.S. Patent Application Publication No. 2004/0214412 (Barnes) in view of Van Suchtelen et al., U.S. Patent No. 4,916,089 (Van Suchtelen). Applicants respectfully traverse the rejections for at least the following reasons.

Claim 1 has been amended to recite a method of growing a p-type nitride semiconductor material by molecular beam epitaxy using bis(cyclopentadienyl) magnesium (Cp_2Mg) during the growth process, and by "<u>carrying out the growth process out at a temperature from 920°C to 960°C so that carbon contamination caused by Cp_2Mg is reduced in the semiconductor material</u>." Support for the amendment may be found in the application at least at page 5, line 25 to page 6, line 4. As further described below, neither Barnes nor Van Suchtelen addresses the issue of reducing carbon contamination. Accordingly, one skilled in the art would not combine Barnes and Van Suchtelen, and a combination of Barnes and Van Suchtelen does not result in or disclose the claimed invention.

The Examiner indicates that Barnes discloses an MBE process in which magnesium is used as the p-type dopant material. The Examiner states that the process of Barnes includes most of the features of the MBE process recited in the claims. Barnes, however, discloses that the source of magnesium is elemental magnesium supplied at a pressure of at least 1×10^{-9} mbar, rather than Cp_2Mg. (See

paragraphs [0043-0044].) The Examiner recognizes that Barnes does not disclose the use of Cp_2Mg as a p-type dopant.

The Examiner, however, states that Van Suchtelen discloses the use of Cp_2Mg as the p-type dopant in an MBE process, and concludes that it would have been obvious to combine the processes of Barnes and Van Suchtelen to arrive at the claimed invention. In the table at the top of column 7, Van Suchtelen appears to disclose the use of Cp_2Mg as a p-type dopant. In one embodiment, the reactor chamber may be a "universally usable CVD [chemical vapor deposition] reactor". Van Suchtelen also states that the "reactor can also be employed for Si epitaxy." (Van Suchtelen at col. 7, lines 33-39; see also col. 2, lines 34-44 and claim 2.) Based on these passages, the Examiner concludes that Van Suchtelen discloses the use of Cp_2Mg as the p-type dopant in an MBE process.

Neither Barnes nor Van Suchtelen, however, addresses the issue of reducing carbon contamination, as recited in amended claim 1.

As stated in the application, MBE methods are superior to MOCVD methods in that MBE methods avoid the need for post-growth annealing or irradiation steps common in MOCVD methods. (See Application at page 3, line 31 to page 4, line 5; page 11, lines 16-25). Prior to the current invention, however, an MBE method employing Cp_2Mg as the magnesium source would have been ***widely expected*** to result in undesirable carbon contamination in the resultant semiconductor layers, and therefore Cp_2Mg was generally avoided in conventional MBE methods. (Application at page 4, lines 26-28.) One skilled in the art, therefore, would not modify a conventional MBE process (such as that of Barnes) to employ Cp_2Mg as the magnesium source.

Applicants have found, however, that carbon contamination is reduced by carrying out the growth process within a specific high temperature range, particularly a temperature range of 920°C to 960°C. (See Application at page 5, line 25 to page 6, line 4.) These features have been incorporated into claim 1 and render claim 1 non-obvious over Barnes in view of Van Suchtelen.

According to MPEP § 706.02(j), an element of a *prima facie* case of obviousness is that a teaching or suggestion to make a combination of references, and the reasonable expectation of success, must be found in the prior art and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). This element of a *prima facie* case for obviousness is lacking because neither Barnes nor Van Suchtelen addresses the issue of carbon contamination if Cp_2Mg were used as the p-type dopant.

Barnes has a common assignee and shares one of the inventors (Stewart Edward Hooper) with the current application. Barnes describes growing a p-type nitride semiconductor material by MBE without the need for any post-processing step even in the presence of ammonia (Abstract of Barnes), but the Barnes process uses elemental magnesium as the source of magnesium. Because elemental magnesium is employed, carbon contamination is not an issue. Indeed, as is stated in the current application, it is known in the art that the use of Cp_2Mg in an MBE process gives rise to undesirable carbon contamination in the resultant semiconductor layers, and <u>therefore Cp_2Mg is generally avoided in conventional MBE methods</u>, as illustrated by the process of Barnes.

Although Van Suchtelen appears to disclose growing a p-type nitride semiconductor material by MBE using Cp_2Mg (see the table at the top of column 7 of Van Suchtelen), Van Suchtelen, like Barnes, is silent on the issue of carbon contamination. In addition, there is no disclosure in Van Suchtelen regarding the growth conditions or the p-doping levels achieved when Cp_2Mg is used as the dopant apart from any other MBE method. Van Suchtelen, therefore, does not suggest to one skilled how to employ Cp_2Mg as the p-type dopant in a manner that overcomes the known problem of carbon contamination. In addition, because of the carbon contamination problem, one skilled in the art would not modify the process Barnes to use Cp_2Mg as the p-type dopant. In this vein, the skilled person would understand that a simple substitution of Cp_2Mg for elemental magnesium in the Barnes process would result in carbon contamination. Without the solution to such problem, a skilled person one would

not modify Barnes in view of Van Suchtelen because the modification lacks a reasonable expectation of success as required by MPEP§ 706.02(j).

Note that in the context of using elemental magnesium rather than Cp_2Mg, Barnes discloses a processing temperature range from 850°C to 1050°C suitable for elemental magnesium as the p-type dopant, with the preferred range being at least 940°C. (Barnes at paragraph [0035].) However, the range disclosed by Barnes is different from the specific claimed range of 920°C to 960°C suitable for using Cp_2Mg as the dopant while reducing carbon contamination. In particular, Barnes does not disclose a lower limit of 920°C or an upper limit of 960°C at all, and Barnes does not suggest any temperature range suitable for reducing carbon contamination. It is only in view of the carbon contamination caused by Cp_2Mg that Applicants have come to realize the suitable temperature range for a process involving Cp_2Mg. From the combined disclosures of Barnes and Van Suchtelen, to arrive at the claimed invention one skilled in the art independently would have needed to (1) identify the problem of carbon contamination, and (2) thereafter identify the specific temperature range for overcoming the carbon contamination. Barnes and Van Suchtelen, whether viewed individually or in combination, are silent on both these features.

Accordingly, Barnes and Van Suchtelen, whether viewed individually or in combination, do not disclose or suggest "carrying out the growth process at a temperature from 920°C to 960°C so that carbon contamination caused by Cp_2Mg is reduced in the semiconductor material", as recited in amended claim 1. Claim 1, therefore, is not obvious over Barnes in view of Van Suchtelen, and claims 2-6, 11, and 13-18 are not obvious for at least the same reasons.

B. Claims 19-20

Claims 19-20 stand rejected pursuant to 35 U.S.C. § 103(a) as being obvious over Barnes and Van Suchtelen, and further in view of a more tertiary reference, Hooper et al., U.S. Patent Application Publication No. 2002/0117103 (Hooper). Hooper is cited as disclosing the pressures of supplied elemental gallium and aluminum, as recited in claims 19 and 20. Hooper does not supply the deficiencies of the combination

of Barnes and Van Suchtelen, described above, and the Examiner does not indicate otherwise.

For at least these reasons, claims 1-6, 11, and 13-20 are not obvious over Barnes, Van Suchtelen , and Hooper, whether individually or in any combination thereof. Accordingly, the rejection of these claims should be withdrawn.

II. CONCLUSION

For the foregoing reasons, claims 1-6, 11, and 13-20 are believed to be allowable and the application is believed to be in condition for allowance. A prompt action to such end is earnestly solicited.

Should the Examiner feel that a telephone interview would be helpful to facilitate favorable prosecution of the above-identified application, the Examiner is invited to contact the undersigned at the telephone number provided below.

Respectfully submitted,

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